Revision 1*
November 1986

U.S. NUCLEAR REGULATORY COMMISSION

# REGULATORY GUIDE

OFFICE OF NUCLEAR REGULATORY RESEARCH

REGULATORY GUIDE 3.52
(Task CE 308-4)

# STANDARD FORMAT AND CONTENT FOR THE HEALTH AND SAFETY SECTIONS OF LICENSE RENEWAL APPLICATIONS FOR URANIUM PROCESSING AND FUEL FABRICATION

*The substantial number of changes in this revision has made it impractical to indicate the changes with lines in the margin.

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

## INTRODUCTION

Section 70.33, "Renewal of Licenses," of 10 CFR Part 70, "Domestic Licensing of Special Nuclear Material," specifies that applications for renewal of a license (including licenses for uranium processing and fuel fabrication) should be filed in accordance with §§ 70.21 and 70.22. Sections 70.21, "Filing," and 70.22, "Contents of Applications," provide general information for filing license renewal applications. This regulatory guide, "Standard Format and Content for the Health and Safety Sections of License Renewal Applications for Uranium Processing and Fuel Fabrication" (herein referred to as the Standard Format), has been prepared to provide more specific guidance for the preparation of the health and safety sections of license renewal applications.

The NRC staff suggests the use of this revised Standard Format for renewal applications to facilitate their preparation by uranium processing and fuel fabrication licensees and their timely and uniform review by the NRC staff. Information contained in previous submittals, statements, or reports filed with the NRC under the license may be incorporated by reference provided such references are clear and specific. The information called for in this regulatory guide that is incorporated by reference to a previous application should be summarized.

A renewal application should be filed in proper form not less than 30 days prior to expiration of the existing license (see paragraph 70.33(b) of 10 CFR Part 70). However, the NRC staff suggests that earlier filing is preferable.

The renewal application for the health and safety sections of the license consists of two major parts. The first part contains the proposed license conditions stating the performance requirements to which the applicant proposes to commit. The second part contains detailed safety information and descriptive information demonstrating the applicant's adherence to the conditions of the first part. This Standard Format is designed to separate the requirements in Part I (license conditions) from the descriptive information in Part II (demonstration and performance record). The information in Part I is of major importance to the NRC inspection and enforcement staff and should be written to be inspectable and verifiable. The information in Part II, on the other hand, is of major importance to the NRC licensing staff during the review of the license renewal application and should be written to provide the basis for licensing decisions. The Standard Format is acceptable to the NRC staff, but conformance is not required. Renewal applications with different formats will be acceptable to the staff if they provide an adequate basis for the findings required for the issuance of a license.

The NRC's requirements for information needed in its review of applications for licenses to possess and use special nuclear material (SNM) for uranium processing and fuel fabrication may change. The contents of the Standard Format will be revised to reflect rule changes. Revisions of the NRC's needs for the information in connection with licensing will be conveyed to the industry and the public in the following principal ways: (1) by revisions to the Standard Format, (2) by the issuance of new or revised regulatory guides, (3) by public announcements, and (4) by direct communications to the applicant from the NRC staff as needed.

Any information collection activities mentioned in this regulatory guide are contained as requirements in 10 CFR Part 70, which provides the regulatory basis for this guide. The information collection requirements in 10 CFR Part 70 have been cleared under OMB Clearance No. 3150-0009.

## Purpose and Applicability

This Standard Format has been prepared to identify the type and quality of information needed in an application for license renewal. It is recognized that the physical size, process scope (chemical or mechanical), and plant capacity all have a bearing on the complexity and level of license application detail. If additional guidance is required, the applicant is invited to confer with the NRC staff prior to or during the preparation of the application.

In the renewal application, the applicant should analyze the plant in terms of potential hazards and the means, including appropriate margins of safety, employed to protect against these hazards. Sufficient information should be included in Part II to allow the NRC licensing staff to perform independent analyses to confirm conclusions reached by the applicant. These analyses should include but are not limited to (1) the site and its relationship to accidents from natural phenomena, (2) operations involving radiation exposures, releases to the environment, and the application of the principle of as low as is reasonably achievable (ALARA), (3) nuclear criticality safety, (4) operations involving hazardous chemicals, (5) confinement and control of radioactive materials, (6) projected effluent quantities and concentrations and effluent treatment, (7) reliability of the systems essential to safety, (8) prevention and control of fire and explosion, (9) radiological contingency planning, and (10) environmental impact associated with normal operations, abnormal conditions, and accidents.

The renewal application should demonstrate the degree of skill, care, and effort used by the applicant in the uranium processing and fuel fabrication activities. To this end, the applicant may provide in-depth analyses as supplemental reports incorporated in the application by clear and specific references. Common literature or references that are readily available need not be supplied with the application.

## Proprietary Information

Proprietary information should be submitted separately. When submitted, it should be clearly identified and accompanied by the applicant's justifications for requesting its being withheld from public disclosure, as specified by § 2.790, "Public Inspections, Exemptions, Requests for Withholding," of 10 CFR Part 2, "Rules of Practice for Domestic Licensing Proceedings." The NRC staff's review of the safety analysis should depend as much as possible on nonproprietary information.

## Style and Composition

The applicant should strive for clear, concise presentation of the information provided in the application.

Where numerical values are stated, the number of significant figures given should reflect the accuracy or precision to which the number is known. Where appropriate, estimated limits of errors or uncertainty should be given.

Abbreviations should be consistent throughout the application and should be consistent with generally accepted usage. Any abbreviations, symbols, or special terms not in general usage or unique to the plant should be defined when they first appear in the application or should be presented in a separate "Glossary" of terms and definitions.

References used should appear either as footnotes to the page where referenced or at the end of each chapter.

## Graphical Presentations

Graphical presentations such as drawings, maps, diagrams, sketches, and tables should be employed where the information may be presented more adequately or conveniently by such means. Due concern should be taken to ensure that all information so presented is legible, that symbols are defined, and that scales are not reduced to the extent that visual aids are necessary to interpret pertinent items of information. These graphical presentations should be located in the section where they are primarily referenced.

## Physical Specifications

### Paper size

Text pages: 8-1/2 x 11 inches

Drawings and graphics: 8-1/2 x 11 inches; however, a larger size is acceptable provided the finished copy when folded does not exceed 8-1/2 x 11 inches.

Paper stock and ink. Suitable quality in substance, paper color, and ink density for handling and reproduction by microfilming or image-copying equipment.

Page margins. A margin of no less than 1 inch should be maintained on the top, bottom, and binding side of all pages submitted.

### Printing

Composition: text pages should be single spaced.

Type face and style: should be suitable for microfilming or reproduction by image-copying equipment.

Reproduction: may be mechanically or photographically reproduced. All pages of text should be printed on both sides and the image printed head-to-head.

Binding. Pages should be punched for standard 3-hole loose-leaf binders.

Page numbering. Pages should be numbered with the digits corresponding to the chapter followed by a hyphen and a sequential number, e.g., the third page of Chapter 4 should be numbered 4-3. Do not number the entire report sequentially.

Table of Contents. A table of contents and an index of key items should be included in each volume of the renewal application.

## Procedures for Updating or Revising Pages

Data and text should be updated or revised by replacing pages. The changed or revised portion on each page should be highlighted by a "change indicator" mark consisting of a bold vertical line drawn in the margin opposite the binding margin. The line should be of the same length as the portion actually changed. All pages submitted to update, revise, or add pages to the report should show the date of change and a revision or amendment number. A guide page listing the pages to be inserted and the pages to be removed should accompany the revised pages. Where major changes or additions are made, a revised table of contents should be provided.

# PART I

## LICENSE CONDITIONS

Part I of the application contains the proposed license conditions stating the performance requirements to which the licensee proposes to commit. These sections should not contain the detailed descriptive material that is more appropriate in Part II. This part should be written to permit inspection and verification of the stated performance requirements.

If requested information is contained in previous submittals, clear and specific reference to these submittals is acceptable.

## Chapter 1 STANDARD CONDITIONS AND SPECIAL AUTHORIZATIONS

### 1.1 Name, Address, and Corporate Information

The licensee should furnish its full name and address. If the address of the uranium processing and fuel fabrication plant (or plants) is different from that of the licensee, it should be given also. The State where the licensee is incorporated or organized and the location of the principal office should be indicated.

### 1.2 Site Location

The location of the plant site, i.e., State, county, and municipality, should be given. Also describe the site, plant boundaries, buildings, and other areas and facilities where licensed activities will be conducted.

### 1.3 License Number and Period of License

The licensee should state the number of the license to be renewed and the period of time for which license renewal is requested.

### 1.4 Possession Limits

The maximum quantity (kilograms) of special nuclear material (SNM) to be possessed and used under the license should be identified. The chemical and physical forms should also be provided. Similar information (i.e., material identification, physical form, maximum mass or curie content) for other nuclear materials subject to this license should also be identified.

### 1.5 Authorized Activities

A summary of all activities, locations, and types of processes in which SNM and other nuclear materials subject to this license are to be used should be provided.

### 1.6 Exemptions and Special Authorizations

Specific exemptions and special authorizations should be listed in this section and justified in the appropriate section in Part II (e.g., criticality monitor alarms, release limits, offsite possession).

## Chapter 2 ORGANIZATION AND ADMINISTRATION

### 2.1 Organizational Responsibilities and Authority

Key positions with responsibilities that are important to safety should be identified and their functions described. The licensee should provide separate lines of authority for production and safety functions. The lines of responsibility leading to top management should be indicated.

### 2.2 Personnel Education and Experience Requirements

The application should contain a description of the minimum qualifications and requirements (i.e., education, training, and experience) for all positions that are important to safety and for safety committee members.

### 2.3 Safety Committees

The application should contain a list of the safety committees (e.g., nuclear criticality safety, ALARA, fire, operational events). The function and responsibility of each should be described. The description should include the purpose, charter of responsibilities, frequency of meetings, audit and inspection responsibilities, frequency of audits, membership, and reporting and recordkeeping requirements.

### 2.4 Approval Authority for Personnel Selection

The licensee should state the management level responsible for selecting personnel for staff positions that are important to safety and for safety committees.

### 2.5 Training

The application should contain a commitment to a program that includes training in radiological safety for all personnel with access to restricted areas, training in special skills, training in criticality safety control, and retraining of previously trained employees at specified frequencies. The retraining program should include updating and changes in required skills. Methods for verifying the effectiveness of training should be identified. A system for maintaining records on this training should also be included.

### 2.6 Operating Procedures

The licensee should state a commitment to conduct activities involving licensed materials in accordance with approved written procedures. The control system that ensures that written procedures are prepared, reviewed, revised, approved, and implemented should be described.

## 2.7 Internal Audits and Inspections

The licensee should state its requirements for internal audits and inspections.[1] Audits and inspections should be conducted at specified frequencies to determine that plant operations are conducted in compliance with regulatory requirements, license conditions, and written procedures. Audits and inspections should apply to radiation protection, nuclear criticality safety control, hazardous chemical safety, fire protection, and environmental protection and should be performed according to a written plan. Qualified personnel without direct responsibility for the function and area being audited should be used for audits. Inspections should be performed routinely by qualified staff personnel that are not responsible for production activities. The staff positions and committees responsible for audits and inspections should be specified. The level of management to which results are reported and the system to ensure that corrective action is taken should also be described.

## 2.8 Investigations and Reporting

The application should contain a description of the procedures for complying with the requirements for reportable incidents. The management positions responsible for investigating, recording, reporting, and following up on actions of reportable incidents should also be identified.

## 2.9 Records

The application should include a description of the types of records related to health and safety and the retention time for these records. Such records should include changes related to systems that are important to safety made under internal review and approval (including nuclear criticality safety analyses), unusual operational incidents, audits and inspections, instrument calibration, ALARA findings, employee training and retraining, personnel exposures, routine radiation surveys, environmental surveys, and routine radioactive effluents.

[1]Audits are formal examinations made to verify that operations are being conducted according to established criteria. Inspections are routine reviews to check that operations are being conducted according to approved procedures. Audits are more formal and less frequent than inspections.

# Chapter 3 RADIATION PROTECTION

## 3.1 Special Administrative Requirements

### 3.1.1 ALARA Policy

The licensee should state its policy for keeping occupational radiation exposures and radioactive contamination in effluents as low as is reasonably achievable (ALARA) and designate responsibility for its implementation.

### 3.1.2 Radiation Work Permit Procedures

Radiation work permits (RWPs) should be issued whenever an activity involving licensed materials is not covered by a written operating procedure and the radioactivity levels are likely to exceed the limits specified in 10 CFR Part 20. The criteria for issuing and terminating RWPs, including the positions for authorizing an RWP, should be described.

### 3.1.3 Written Procedures

The application should contain a commitment to conduct activities related to radiation protection (e.g., decontamination and maintenance of processing equipment, radiation monitoring) in accordance with approved procedures. A description of how these procedures will be made available to appropriate personnel should also be provided in this section.

## 3.2 Technical Requirements

### 3.2.1 Restricted Areas--Personnel Contamination Control

The application should contain criteria for radiation control in restricted areas. The methods to be used to control entry and exit should be specified. Discussions should include:

1. Change rooms. Physical limits (e.g., step-off pads) and the means of access control should be identified.

2. Protective clothing. The policy on the use of protective clothing and change facilities should be stated.

3. Personnel monitoring systems. The types and availability of monitoring equipment should be specified. The policy on the use of personnel monitoring systems should be stated.

4. Personnel decontamination policy. The minimum provisions for personal decontamination should be specified.

### 3.2.2 Ventilation

The application should contain the criteria for the design, operation, and testing of ventilation systems. The criteria should include the minimum flow velocity at hood faces, the maximum differential pressure measurement across filters, the frequency of system checks, and the use of filters or scrubbers at the inlet to exhaust and recirculation systems.

### 3.2.3 Work-Area Air Sampling

The application should contain a commitment to conduct programs for determining airborne radioactivity in work areas. The description should include the location of air samplers, the types of equipment, the minimum detectable activity, and the frequency of sampling and analyses. Specify the radioactivity levels at which action will be taken and describe the actions to be taken.

### 3.2.4 Radioactivity Measurement Instruments

The application should identify the types of instruments used for measuring radioactivity. The purpose (e.g., radiation analyses, radiation surveys, criticality alarm systems, personnel monitoring), range, sensitivity, alarm setpoints, calibration method and frequency, and testing should be described.

### 3.2.5 Radiation Exposures

The application should contain a commitment to conduct programs for determining, validating, and controlling occupational exposures, including the types and frequency of measurements. Specify the dose levels at which action will be taken and describe the actions to be taken if these levels are exceeded.

### 3.2.6 Surface Contamination

The allowable limits on surface contamination (fixed and removable) should be specified for clean (uncontrolled), intermediate (change rooms), and controlled areas. The action levels for immediate and delayed cleanup should be specified for each type of area. The actions to be taken if action levels are exceeded should be described. The frequency and method of surface contamination surveys in each type of area should be specified.

### 3.2.7 Bioassay Program

The application should contain a commitment to conduct bioassay measurements in accordance with Regulatory Guide 8.11, "Applications of Bioassay for Uranium." The frequency of data collection and types of measurements (urinalysis, fecal, in vivo) should be specified. The commitment should include diagnostic bioassays whenever airborne radioactivity level limits specified in Section 3.2.3 are exceeded.

# Chapter 4 NUCLEAR CRITICALITY SAFETY

## 4.1 Administrative Conditions

The licensee should propose license conditions regarding:

1. Its design philosophy for equipment and systems used for processing SNM. The double contingency principle endorsed by Regulatory Guide 3.4, "Nuclear Criticality Safety in Operations with Fissionable Material at Fuels and Materials Facilities," is acceptable for the minimum degree of safety. It is expected that favorable geometry will be the principal method used for designing equipment for nuclear criticality safety.

2. Its requirements and the titles of the positions with the responsibilities for nuclear criticality safety. The responsibility for initiating and performing criticality safety analyses, independent review of these analyses, and management approvals should be identified by organizational positions. If favorable geometry is not used as the method for criticality control, a specific procedure to ensure that management is aware and approves of the method should be established. Regulatory Guide 3.4 provides information that may be useful when developing this part of an application.

3. Its requirements for documenting analyses and reviews. Provisions for written documentation and records retention of criticality safety limits and controls should be established.

4. Its requirements to use written procedures that have been reviewed and approved according to a formal management process for all operations involving SNM. The process should include developing nuclear criticality safety limits and controls derived from specific nuclear criticality safety analyses.

5. Its requirements for posting criticality safety limits at locations where SNM is processed, handled, and stored.

6. Its requirements for the preoperational testing and inspection of new or modified systems.

7. Its use of approved written procedures for activities related to nuclear criticality safety design.

## 4.2 Technical Criteria

The licensee should propose criteria for and specify limits and controls for nuclear criticality safety that will be used in the design of buildings, systems, and equipment where SNM is processed.

### 4.2.1 Individual Units

The basic assumptions and design conditions to be used for nuclear criticality analyses for isolated equipment and systems should be listed in this section. Examples of such design assumptions and conditions are:

1. The dependence of nuclear criticality safety on the degree of internal moderation.

2. The dependence of nuclear criticality safety on the use of fixed poisons (e.g., borosilicate-glass Raschig rings).

3. The dependence of nuclear criticality safety on neutron reflector thickness for the reflector of interest.

4. The dependence of nuclear criticality safety on optimum heterogeneity for the system. The credibility of assumed heterogeneity should be assessed.

5. The dependence of nuclear criticality safety on the enrichment of U-235, the concentration of fissile material, and diluents or poisons.

6. The dependence of nuclear criticality safety on the accumulation of fissile material in locations other than those specifically designed for accumulation. When administrative control is used to prevent excessive accumulation of fissile material in process equipment and components (e.g. ventilation ducts), methods for limiting accumulation should be described. The description should include methods for safe removal of any accumulated material.

7. The safety margins selected for individual units based on normal and accident (e.g., flooding, multiple batching, loss of spacing) conditions.

8. The design bases to ensure structural integrity of structures, systems, and components important to safety.

4.2.2 Multiple Units or Arrays

The basic assumptions and design conditions to be used for nuclear criticality analyses for multiple units and arrays should be listed in this section. Examples of such design assumptions and conditions for arrays of units are:

1. The dependence of nuclear criticality safety on minimum edge-to-edge separation.

2. The dependence of nuclear criticality safety on interspersed moderation.

3. The dependence of nuclear criticality safety on an array neutron reflector thickness for the specific reflector material.

4. The design bases to ensure structural integrity of racks, spacers, and other items.

5. The safety margins for normal and accident conditions.

4.2.3 Technical Data and Validation of Calculational Methods

Tables or graphs of technical data should be provided as applicable. These could include, for example, safe mass, volume, or geometry as a function of U-235 enrichment or edge-to-edge spacing for units in a large but finite array, etc.

Describe the calculational methods that have been validated and that will be used. The description should include, as applicable, the range of applicability, bias, cross-section sets, definition of terms, and other pertinent information. Regulatory Guide 3.4 provides information on validation.

4.2.4 Special Controls

This section should include proposed license conditions concerning plant-specific or unique nuclear criticality safety considerations such as fire protection, moderator control for individual units and arrays, and process instrument calibration (e.g., schedules, conditions for startup, conditions for normal operation).

# Chapter 5 ENVIRONMENTAL PROTECTION

## 5.1 Effluent Control Systems

The levels of radioactivity and hazardous chemicals not regulated by the State in gaseous and liquid effluents that require a commitment to action should be specified. The radiation levels should be selected to meet NRC regulatory limits, including ALARA commitments. The application should contain a description of anticipated corrective actions to be taken if these limits are exceeded. Limits at which an operation will be shut down should be specified. Regulatory Guide 4.16, "Monitoring and Reporting Radioactivity in Releases of Radioactive Materials in Liquid and Gaseous Effluents from Nuclear Fuel Processing and Fabrication Plants and Uranium Hexafluoride Production Plants," provides information on effluent monitoring programs.

## 5.2 Environmental Monitoring

A radiological environmental monitoring program for evaluating radioactivity released from the plant should be established. The program should include the methods and frequency of sampling and analysis of air, soil, vegetation, surface water, and ground water. The radioactivity level limits for a commitment of action should be specified and a description of the actions to be taken should be presented.

## Chapter 6 SPECIAL PROCESSES

### 6.1 Proprietary Information

The application should contain descriptions of special procedures or actions required for unique processes or operations. Descriptions of special processes may contain proprietary information, which should be submitted separately in accordance with § 2.790 of 10 CFR Part 2.

### 6.2 Occupational Safety

Action levels and corrective actions should be identified for events involving radioactive and hazardous chemicals that could significantly affect safety. The licensee should specify maximum permissible concentrations, threshold value limits, and permissible exposure limits for fluorides and other hazardous chemicals.

### 6.3 Emergency Utilities

The application should contain a description of the systems and equipment that provide auxiliary utility services that are important to safety. For instance, an emergency electric power supply should be available to provide light for emergency exits and to maintain operability of accidental criticality monitors and alarms and other radiation detection instrumentation.

### 6.4 Radioactive Waste Management

The application should contain a description of the processes and systems used for handling, storing, and disposing of radioactive wastes. If radioactive wastes are stored on the site, methods for confinement and monitoring the confinement should be explained.

## Chapter 7 DECOMMISSIONING PLAN

The licensee should reaffirm the commitment to decommission the facility and the site at the end of its operation in a manner that will protect the health and safety of the public. Plans for decontaminating the facility and site so the facility and grounds can be released for unrestricted use should be provided. The application should include an updated estimate of the costs involved and a description of the financial arrangements made to ensure that adequate funds will be available to cover these costs at the time of decommissioning.

## Chapter 8 RADIOLOGICAL CONTINGENCY PLAN

A radiological contingency plan that follows the guidance in NUREG-0762[2] should be submitted as an attachment to the application.

[2]NUREG-0762, "Standard Format and Content for Radiological Contingency Plan for Fuel Cycle and Materials Facilities," is available from the Superintendent of Documents, U.S. Government Printing Office, P.O. Box 37082, Washington, DC 20013-7982.

# PART II

## SAFETY DEMONSTRATION

Part II of the application contains detailed information demonstrating the applicant's adherence to the license conditions. The information submitted in this part should be written to provide a basis for licensing decisions.

If requested information is contained in previous submittals, clear and specific reference to these submittals is acceptable.

## Chapter 9 GENERAL INFORMATION

### 9.1 Corporate Information

The application should contain a description of the corporate structure of the uranium processing and fuel fabrication organization. If the organization is made up of two or more persons, the relationship and responsibilities of each should be explained.

### 9.2 Financial Qualification

The licensee should provide sufficient information to demonstrate the financial capability for operating and decommissioning the plant. A copy of the latest corporate annual report may satisfy this requirement.

### 9.3 Summary of Operating Objective and Process

The application should contain a summary of the uranium processing and fuel fabrication activities, including the function and operation, process capacity, feed and products, and processes used. In particular, identify any processing changes or additions made since the last license renewal.

### 9.4 Site Description

The application should contain information on the location of the plant and a description of the geographic, demographic, meteorologic, hydrologic, seismologic, and geologic characteristics of the site and its surroundings. The objective is to indicate what, if any, site characteristics influenced the plant design and mode of operation.

### 9.5 Location of Buildings On Site

The application should contain descriptive information on the buildings and other installed features of the plant and their location on the site. In particular, identify any changes or additions made since the last license renewal.

### 9.6 Maps and Plot Plans

A map of the site should be included in the application; it should be of suitable scale to clearly define the boundary of the site and the distance from significant facility features to the site boundary. The area to be considered as the exclusion area should be clearly delineated if its boundaries are not the same as the boundaries of the plant site. A general location map encompassing at least an 80-km (50-mi) radius should also be provided. The application should show any unusual hazard such as a dam upriver from the plant, failure of which could cause flooding at the plant site. Additional maps and site plots should be provided to present details near the plant and to establish the orientation of buildings, streams, ponds, and neighboring structures. The location of the site relative to prominent natural and man-made features and the distance and direction to the nearest population centers should be stated.

## 9.7 License History

The license number, original license issue date, and subsequent renewal dates should be given.

# Chapter 10 FACILITY DESCRIPTION

## 10.1 Plant Layout

Through the use of drawings and flowsheets, the layout and functional features of the licensed activities should be described. The application should contain plans and elevations in sufficient detail to identify all features to be discussed in this chapter. Spatial and equipment identification data should be included on the layouts or designated in tabular listings. In particular, changes made since the last submittal should be identified.

## 10.2 Utilities and Support Systems

### 10.2.1 Electric Power

The source and characteristics of the primary electrical system providing normal power to the plant should be described. The application should also identify the systems and equipment that are provided with emergency electric power. The design, operation, and testing of the emergency power source or sources should be described.

### 10.2.2 Compressed Air

The design basis for supplying the compressed air needs of the plant, including air for instrumentation, protective masks, and protective clothing, should be presented. The air system components, location, distribution, and operating characteristics should be described.

### 10.2.3 Water

The primary source of the water supply, alternative sources, storage facilities, and plant supply loops should be discussed. The quantities of water used under normal and abnormal conditions by service (i.e., potable, process, and fire control) should be specified. The effects of a loss of water supply source, failure of main supply pumps or supply loops, and power failure should be discussed.

## 10.3 Ventilation Systems

The operation and testing of ventilation systems that are important to safety should be described. Emphasis should be placed on the provisions for coping with releases and the accumulation of licensed materials.

## 10.4 Radioactive Waste Handling

### 10.4.1 Liquid Wastes

Sources of radioactive liquid wastes and the liquid waste treatment systems used to process these wastes should be described. The processes and systems for storage, volume reduction, and solidification of radioactive wastes should be described. Items such as process and maintenance wastes, laboratory wastes, liquid spills, and cleanup and decontamination solutions should be included. The methods for monitoring confinement should be described. The discussion should relate processes and equipment to radioactivity and hazardous chemical

concentrations, volumes, and quantities. The provisions for storage should be described, and the streams that are processed to achieve volume reduction or solidification should be identified. The description should be accompanied by appropriate engineering drawings to show flow paths and the locations of equipment.

### 10.4.2 Solid Wastes

Solid wastes that are produced as a result of plant operation should be identified, and the systems used to treat and confine these solid wastes should be described. These descriptions should include the following information:

1. The methods and equipment selected for minimizing the generation of solid wastes and for the safe management of the solid waste that is generated.

2. The equipment and associated features that are used for volume reduction, confinement or packaging, storage, and disposal.

3. The physical, chemical, and thermal characteristics of the solid wastes, including an estimate of concentrations and volumes generated.

For solid wastes that are to be retained on the site, the confinement and storage methods should be described. The monitoring of the confinement structures and systems should be discussed.

## 10.5 Fire Protection

The codes and standards considered and used for the design of the buildings and the fire protection systems, including published standards of the National Fire Protection Association, should be listed.[3] Provide evidence of the adequacy of the fire protection program for the facility through nuclear liability and property insurance coverage and inspection reports.

Describe the design and selection of fire protection equipment, the inspection and testing of the physical aspects of the system, the development of the fire protection program, and the training in firefighting for the operating plant. State by position the personnel responsible for inspecting and maintaining the fire protection equipment. Procedures for storing combustibles and combustible radioactive waste should be described.

[3]It is recommended that ANSI N665-1985, "Facilities for Fabricating Fuel for Light Water Reactors (LWR)--Fire Protection," be used. Copies may be obtained from the American National Standards Institute, 1430 Broadway, New York, New York 10018.

## Chapter 11 ORGANIZATION AND PERSONNEL

The organization for operating the facility should be described in sufficient detail to indicate how the applicant intends to ensure that a technically competent staff will be maintained to provide continued implementation of administrative and operating procedures and programs that relate to health and safety.

### 11.1 Organizational Responsibilities

The managerial responsibilities relative to the health and safety aspects of the facility should be described. The application should contain a description of the organization, including the title of each position that is important to safety, the qualifications of personnel occupying each position, and the flow of responsibility as depicted by an organization chart.

### 11.2 Functions of Key Personnel

The functions, responsibilities, and authorities of key personnel positions should be described. A discussion of specific succession to the responsibility for operating the plant in the event of absences, incapacitation, or other emergencies should be included.

### 11.3 Education and Experience of Key Personnel

The résumés of personnel assigned to positions that are important to safety should be presented. Identify individuals by position and title and describe their formal education, training, and experience.

### 11.4 Operating Procedures

The method and organizational positions involved in the preparation, review, and approval of written procedures for plant operation should be described. The method by which procedures are made available for use by plant personnel should also be described.

### 11.5 Training

The application should contain a description of the training program for employees and the program for reinstruction when changes are made to processes involving nuclear materials, nuclear criticality safety controls, radiation protection procedures, fire protection, or emergency procedures. Specialized training should be commensurate with the extent of the employee's contact with radioactive materials.

The training program should include ALARA practices, instrumentation and control, methods of dealing with process malfunctions, nuclear criticality safety, fire protection, control of contamination, decontamination procedures, and emergency procedures. General subjects such as the nature and source of radiation, interactions of radiation and matter, biological effects of radiation, and use of radiation monitoring equipment should also be included.

### 11.6 Changes in Procedures, Facilities, and Equipment

Responsibility for initiating changes in procedures, facilities, and equipment should be described. The licensee should describe the administrative

procedure and controls that will ensure that an analysis and independent safety review of any proposed activity is performed and documented prior to the start of the new activity or change in an existing activity involving licensed material. The administrative procedure should include:

1. Analysis. The evaluation of the proposed change, including the analysis of potential accidents that may affect radiation safety and nuclear criticality safety, should be documented.

2. Review. The management positions responsible for review and approval prior to effecting a change should be identified.

3. Approval. Implementation of the proposed change should take place only after final approval in writing by the designated management personnel.

4. Verification. An audit should be made when approved changes are implemented. Periodic inspections of operations should be made to ensure compliance. The positions responsible for the inspection should be indicated.

5. Records. Sufficiently detailed records to permit independent review of the analyses and approval should be maintained.

## Chapter 12 RADIATION PROTECTION

### 12.1 Program

The program for conducting radiation surveys and the plans that have been developed for ensuring that occupational radiation exposure will be ALARA should be described. Also describe the methods for monitoring personnel exposures and the contamination of equipment and surfaces and the actions taken to control them. The guidance in the following regulatory guides should be used in developing this program:

8.9 Acceptable Concepts, Models, Equations, and Assumptions for a Bioassay Program

8.10 Operating Philosophy for Maintaining Occupational Radiation Exposures As Low As Is Reasonably Achievable

8.11 Applications of Bioassay for Uranium

8.24 Health Physics Surveys During Enriched Uranium-235 Processing and Fuel Fabrication

### 12.2 Posting and Labeling

The posting and labeling program used to comply with § 20.203 of 10 CFR Part 20 should be described.

### 12.3 External Radiation--Personnel Monitoring

The personnel monitoring program for external radiation should be described. Indicate what types of personnel monitoring equipment are used to provide data for evaluating doses to individuals and for assigning those doses to specific operations. The type, range, sensitivity, and accuracy of the personnel dosimeters should be provided. Also describe how dosimeter readers are tested for accuracy if the personnel dosimeters are read by the licensee. Specify the frequency for reading personnel dosimeters and recording the radiation dose. Also describe how dosimetry results will be used as a guide to operational planning.

### 12.4 Radiation Surveys

The application should contain descriptions of the routine radiation survey program and special surveys for planning and preparing maintenance operations to ensure that occupational exposures are ALARA. Describe the bases for these activities, for example, using surveys to obtain information on radiation, contamination, and airborne radioactive material.

### 12.5 Reports and Records

Reports should conform to reporting commitments in Section 2.9 of Part I. Records that will be maintained and their required retention times should be described. The records should include principal maintenance, alterations or additions made, unusual operational incidents, events associated with radio-

activity releases, audits and inspections, instrument calibration, ALARA findings, employee training and retraining, personnel exposure, routine and special radiation surveys, and environmental surveys.

## 12.6 Instruments

The application should justify the criteria for selecting radiation measurement instruments for:

1. Performing radiation and contamination surveys,

2. Sampling airborne radioactivity,

3. Monitoring area radiation,

4. Monitoring personnel,

5. Radiation analyses.

Instruments and related equipment and the quantities of such equipment provided for plant operations should be described. Also describe the instrument storage, calibration, and maintenance facilities; the health physics facilities; and the laboratory facilities for radioactivity analyses.

## 12.7 Protective Clothing

The application should contain a description of the protective clothing available for operating personnel for normal, maintenance, and accident conditions.[4]

## 12.8 Administrative Control Levels, Including Effluent Control

The application should contain a description of action levels, alarm setpoints, frequency of measurements, and action to be taken for the following radiation protection monitoring programs:

1. Occupational exposure (internal and external),

2. Airborne activity (area and stack or vent monitors),

3. Liquid activity (effluent monitors),

4. Surface contamination (controlled areas, uncontrolled areas, release of equipment or packages).

The application should also contain a description of the sampling method, sampling frequency, analyses, lower limits of detection, instrumentation calibration and testing, method of reporting, and responsibility (by position) for all effluents at their point of discharge. The location of liquid effluent

[4]Refer to "Certified Personnel Protective Equipment List" of the National Institute of Occupational Safety and Health (NIOSH). This list is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

discharge points should be shown and labeled on appropriate plot plans (see Section 9.6). The limits selected for a commitment of action and the actions to be taken should be described. The application should contain a description of the methods for demonstrating compliance with the Environmental Protection Agency's regulations in 40 CFR Part 190, "Environmental Radiation Protection Standards for Nuclear Power Operations" (see paragraph 20.105(c) of 10 CFR Part 20). Regulatory Guide 4.16 provides guidance on effluent monitoring and reporting.

## 12.9 Respiratory Protection

Respiratory protection equipment may be needed to limit the inhalation of airborne radioactive materials and hazardous chemicals. The respiratory protection program for protection against radioactive materials should be described.[5] Regulatory Guide 8.15, "Acceptable Programs for Respiratory Protection," is used by the NRC staff when evaluating programs for protection against airborne radioactive materials.

## 12.10 Occupational Exposure Analysis

As an appendix or addendum to the application, provide an analysis of occupational exposures (external and internal) covering at least the past two years of plant operation for each plant area and type of operation performed. The analysis should identify the sources of major exposures and the locations where they occurred in relation to job categories and work activities. Any trends in exposures that can be identified should be discussed. Unusual operational incidents should be reviewed and categorized by such aspects as frequency, the operations being performed, and the magnitude of the resulting exposure. The analysis of internal exposures should consider air sampling data as well as bioassay data (including in vivo counting). The analysis should conclude with a description of any steps or measures taken to reduce employee exposure, the effectiveness of these measures, and any additional actions planned.

## 12.11 Measures Taken To Implement ALARA

The ALARA program pertaining to radiation workers and ALARA committee activities should be described. The committee's membership and scope should be stated. The procedures for performing the required audits and inspections of operations and for reviewing all new activities or changes in existing activities should also be described. Regulatory Guide 8.10 should be used in developing an ALARA program. A periodic report summarizing employee exposures and effluent release data should be made to senior management.

As part of the ALARA program, the licensee should investigate and report to NRC all incidents and situations that significantly reduce the effectiveness of health and safety programs. For example, the licensee should analyze data from surveillance and monitoring programs for trends that may indicate an increasing trend in radiation exposures. Appendix A lists some events that should be considered for analysis.

[5]Information on generally applicable respiratory protection is contained in the regulations of the Department of Labor, Occupational Safety and Health Administration, in § 1910.134, "Respiratory Protection," of 29 CFR Part 1910.

## 12.12 Bioassay Program

The bioassay program to detect and monitor any significant deposition of radioactive material in the body should be described. The description should include the frequency of data collection and an evaluation of the bioassay sampling (routine and special) program. Regulatory Guides 8.9 and 8.11 may be used as guidance on such topics as (1) the necessity for bioassay procedures, (2) the bioassay techniques to use and their frequency, (3) selecting participants, (4) actions to be taken based on bioassay results, (5) the particular results that should initiate such action, and (6) diagnostic evaluation.

## 12.13 Air Sampling

The application should contain a description of the air sampling and analysis program used for monitoring the concentrations of radioactivity in working areas and detecting the presence of unsafe concentrations. The description should include the location of samplers or monitors, types of equipment (for routine or special use), calibrations, frequency of sampling, analytical methods, and program quality controls. Action levels and the actions to be taken if these levels are exceeded should be specified, including any action level at which an operation will be shut down. Methods used to correlate work-area radioactivity concentrations in air samples with personal dose exposure calculations, including averaging techniques, should be explained. Methods used to corroborate personal dose evaluations, e.g., bioassay sampling and in vivo body counting, should be described. Supply a list of the types and numbers of instruments used for measuring radioactivity in air. Describe conditions, e.g., MPC-hour limits, under which air sampling instruments such as work-area samplers, continuous air monitors, and lapel air samplers will be used.

## 12.14 Surface Contamination

Controlled areas established to prevent the spread of contamination should be identified. Include locations of step-off pads, change facilities, protective clothing facilities, and personnel monitoring instruments. The practice on the use of protective clothing should be stated. Surface contamination surveys, allowable limits (fixed and removable), and action levels for immediate cleanup or delayed cleanup should be specified for clean (uncontrolled) areas, intermediate areas (change rooms), and controlled areas.

The frequency of surface contamination surveys in each area should be stated. A list of types and numbers of instruments used for determining radiation should be supplied. The personnel contamination control and radiation level survey programs, including the survey frequency, the instruments used (type, range, sensitivity, and accuracy), the action levels, and the actions to be taken, should be described.

Guidance on the release of equipment and materials from the plant site is given in a branch technical position entitled "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material," July 1982.[6]

[6]Copies are available from the U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards, Division of Fuel Cycle and Material Safety, Washington, DC 20555.

## Chapter 13 ENVIRONMENTAL SAFETY--RADIOLOGICAL

The environmental monitoring program should be described. The location of sampling points and monitoring stations, including radiation background stations, should be shown on maps or plot plans. The lower limit of detection for the appropriate radionuclides should be included. Regulatory Guide 4.16 provides guidance on determining lower limit of detection.

Using radiation measurements obtained from the environmental monitoring program (including sampling and analysis of surface water, ground water, air, soil, and vegetation and the determination of gamma dose levels at points around the plant) during at least the past two years, the maximum annual dose equivalent to the whole body and to any other organ of any member of the public should be determined.

# Chapter 14 NUCLEAR CRITICALITY SAFETY

## 14.1 Administrative and Technical Procedures

Administrative and technical procedures to ensure nuclear criticality safety in processing, storing, and moving SNM should be described in detail. Written criteria and procedures should be developed and approved for posting criticality safety limits, process analyses, material and operational controls, review of operations, emergency planning, audits and inspections, criticality data sources, and validating criticality calculations and techniques. Describe administrative practices that ensure approved written criteria and procedures, ensure qualified personnel, and establish the responsibility for nuclear criticality safety.

## 14.2 Preferred Approach to Design

The preferred approach to design should be described in this section. If the approach is other than the use of "always favorable geometry," justification should be provided. The design approach should include designs that (1) minimize the possibility of accumulating fissile materials in inaccessible locations (see item 6 in section 4.2.1), (2) make nuclear safety independent of the degree of moderation within a unit and the degree of interspersed water moderation between units, and (3) make nuclear safety independent of neutron reflector thickness. Regulatory Guide 3.4 contains information that may be useful to the licensee. If favorable geometry control is not used (e.g., safe wet mass, concentration control) the applicant or licensee should justify the proper use of unfavorable geometry and establish appropriate administrative controls (see section 3 of Appendix B).

## 14.3 Basic Assumptions

The basic assumptions for nuclear criticality safety analyses should be stated in the application. Some examples are maximum credible fissile material density, the optimum (limiting case) conditions of water moderation and heterogeneity credible for the system, the enrichment, and unit limits based on full reflection if such reflection is credible under normal or accident conditions. The use of less than equivalent full water reflection and the method of analysis to determine the equivalent water reflector thickness should be justified. If a more effective reflector than water is present (e.g., concrete), it should be considered in the analysis.

Safety margins for individual units should be described and justified (e.g., safety factors for large units, dimensions for small units). Safe unit geometry and safe unit spacing may differ from plant to plant, from process to process, and with the SNM content of materials in process. A justification of the minimum spacing between units in process and storage arrays should be provided.

For the convenience of the applicant, criticality safety design methods acceptable to the NRC staff are provided in Appendix B to this guide.

## 14.4 Fixed Poisons

In the event that borosilicate-glass raschig rings are used as a primary or secondary means of criticality control, describe how they are used and maintained. (Guidance is provided in Regulatory Guide 3.1, "Use of Borosilicate-Glass Raschig Rings as a Neutron Absorber in Solutions of Fissile Material.") Alternative poison material may be used if a justification is provided and the justification includes a determination of the initial and continuing presence and effectiveness of the poison material.

## 14.5 Structural Integrity Policy and Review Program

Show that the structural integrity for single units and arrays is ensured by stipulating that engineering designs are reviewed by qualified people and that an adequate margin of safety is ensured under normal and all credible abnormal conditions.

## 14.6 Analytical Methods and Their Validation

Describe and demonstrate the use of and the validation of the analytical methods and their applicability to the systems being analyzed. Regulatory Guide 3.4 contains information useful in validating analytical methods.

## 14.7 Special Controls

Any other special controls used to ensure nuclear safety such as zoning for fire protection should also be described.

## 14.8 Data Sources

The sources or references for applicable data should be specified.

## Chapter 15 PROCESS DESCRIPTION AND SAFETY ANALYSES

### 15.1 Process Steps and Flowsheets

The equipment and process controls for each system, including ancillary systems if pertinent to the main process (e.g., decontamination systems, scrap recycle systems), should be described. In support of the description, provide process, instrumentation, and electrical flowsheets and mass-balance data where pertinent.

### 15.2 Safety Analysis of Each Step

The application should contain a safety analysis, including radiation safety and nuclear criticality safety, for each step of the process. The analyses should show how the commitments specified in Part I will be met.

### 15.3 Safety Features of Each Step

Design features, process systems, and operating procedures important to safety should be described for both normal and abnormal conditions. The adequacy of administrative controls involving nuclear criticality safety should be justified. The limits selected for a commitment of action and the actions to be taken if these limits are exceeded should be specified. A summary of the principal hazards and the approaches used to preclude or mitigate accidents should be provided.

## Chapter 16 ACCIDENT ANALYSES

The types of accidents considered and their potential impact on occupational safety and the environment should be summarized. Appropriate reference to the Environmental Report and Radiological Contingency Plan may be made.

## APPENDIX A

### POTENTIAL TOPICS FOR TREND ANALYSES

[Reference: Section 12.11]

1. Personnel exposures.

2. Concentrations of airborne radioactive and hazardous chemical contamination in plant areas and effluents.

3. Radioactive contamination in areas and on equipment not normally contaminated.

4. Failure of required radiation measurement instrumentation to operate properly.

5. Failure of respiratory protection equipment to work properly.

6. Failure of effluent filters to meet specifications.

7. Calculated or measured offsite exposure to any member of the public.

8. Lapse or failure of a significant nuclear criticality criterion such as:

   a. Accidental double-batching,

   b. Unauthorized transfer of SNM from a safe to an unsafe geometry,

   c. Accidental distortion of safe geometry equipment approaching an unsafe configuration (includes corrosion),

   d. Detection of unexpected accumulations of SNM,

   e. Failure of racks or shelving for SNM,

   f. Receipt of material that is outside of specifications (too much moderation in "dry powder," too high enrichment),

   g. Unexpected loss of effectiveness of poisons (dissolution, distortion),

   h. Unexpected moderation in moderation-controlled units and systems,

   i. Installation and use of unauthorized equipment for SNM, or

   j. Unauthorized modification to approved procedures or use of unapproved work and storage stations for SNM.

## APPENDIX B

## SAFETY MARGINS AND INTERACTION CRITERIA

For the convenience of the applicant, criticality safety design methods that have been accepted by the NRC staff, including maximum safe parameters for individual units and criteria for spacing between units in an array, are provided in this appendix. Whether these or other values are used, the method and values should be justified.

### 1. SAFETY MARGINS

When double-batching is possible, mass limits should be held to no more than 0.45 of the minimum critical mass based on spherical geometry; when double-batching is not possible, the mass should be limited to no more than 0.75 of the critical mass. Mass limits should be based on experimental data or on calculations performed by a method that has been validated for the type of system being analyzed. Acceptable geometry margins of safety for large single units are 90 percent of the minimum critical cylinder diameter, 85 percent of the minimum critical slab thickness, and 75 percent of the minimum critical sphere volume. Maximum safe dimensions should be specified for small units.

Safe cylinder diameters, slab thicknesses, unit masses, and volumes may be tabulated in the application as a function of moderation, enrichment, reflection, etc. The specific values tabulated should meet the above criteria or may correspond to a unit $k_{eff}$ that provides an adequate margin of safety under specified normal and credible abnormal conditions. The evaluated multiplication factor under normal and credible abnormal conditions should be equal to or less than an established maximum safe allowable multiplication factor ($k_a$), i.e.,

$$k_s \leq k_a$$

where

$k_s$ = the evaluated multiplication factor, including any necessary allowance for statistical uncertainties.

The maximum allowable multiplication factor should be calculated from the expression:

$$k_a = k_c - \Delta k_u - \Delta k_m$$

where

$k_c$ = the value of $k_{eff}$ that results from the calculation of benchmark experiments using a particular calculational method. The value represents a combination of theoretical techniques and numerical data.

$\Delta k_u$ = the uncertainty in the benchmark experiments, including random and systematic errors (bias) within the range of parameters encountered in the equipment design.

$\Delta k_m$ = the value required to ensure an adequate margin of subcriticality.

## 2. INTERACTION CRITERIA

The licensee should identify the criteria to be used in spacing. Acceptable criteria for spacing process equipment and stored units include:

1. Values of $k_{eff}$ derived from validated Monte-Carlo calculations should be within the 95% confidence interval.

2. The maximum safe surface density should be limited to 25 percent of the critical surface density of a fully water-reflected uniform slab of the appropriate composition when each unit in the array has a maximum quantity of fuel that is no more than 30 percent of critical for a bare assembly based on container geometry, fuel composition, and the degree of water moderation of interest.

3. The nuclear criticality safety criteria for arrays may be based on the application of the solid angle method. The method of analysis should be demonstrated to be applicable to the system being analyzed.

4. In the application of the density analog method, safety factors of 2 should be used for the maximum allowable number of units. Factors for reflection and moderation must also be applied.

Desirable spacing criteria include:

1. The closest approach of one individually subcritical unit to another should be limited by mechanical means or by clearly delineated criticality zones.

2. The array analysis should allow for double-batching of a single position in the most limiting array position (or positions) credible.

3. The array analysis should account for interunit moderation unless it can be shown that moderation is not credible.

4. The array analysis should include a conservative allowance for spatial tolerance in unit positions.

5. Mixed array criteria should be used where applicable (e.g., solutions and solids).

## 3. UNFAVORABLE GEOMETRY CONTROL

In section 14.2, justification for use of unfavorable geometry is requested. This should include an analysis that (1) identifies potential contributing causes of criticality accidents, (2) shows how such causes will be subject to administrative controls, and (3) shows how the double contingency principle (see Regulatory Guide 3.4) will be applied. Contributing causes of criticality accidents may include, but are not limited to, the following:

1. No detailed written procedures for new process;

2. Process upsets;

3. Inadequate identification of SNM;

4. Failure of audit program;

5. Failure to follow procedures;

6. Changes improperly authorized;

7. Inadvertent mixtures of solvent, aqueous liquors, and raffinates;

8. Failure to completely drain the system;

9. Failure of instruments;

10. Poor communications among personnel, especially from shift to shift;

11 Failure to investigate and correct warning signals;

12. Failure to record SNM transfer;

13. Irregularities in function and operation of valves and equipment;

14. Use of temporary lines and unauthorized equipment for transfer of liquids containing SNM.

## VALUE/IMPACT STATEMENT

A draft value/impact was published with the draft guide when the guide was published for comment. Changes being made to the guide do not alter the bases for the draft value/impact statement, and thus no revision of the draft value/impact statement is required. A separate value/impact statement for the active guide has not been prepared. A copy of the draft value/impact statement is available for inspection and copying for a fee in the Commission's Public Document Room at 1717 H St NW., Washington, DC 20555.

* U. S. GOVERNMENT PRINTING OFFICE: 1988-202-292:60346

**UNITED STATES**
**NUCLEAR REGULATORY COMMISSION**
WASHINGTON, D.C. 20555